NASA SBIR/STTR Technologies

Drag &Drop, Mixed-Methodology-based Lab-on-Chip Design Optimization Software

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Identification and Significance of Innovation

- Integrated biomicrosystems offer low power/weight/cost, automated and high throughput solution to NASA
- Experiment-based design analysis is expensive and lengthy
- Multiphysics simulation offers component level solution, prohibitive when employed for design of complex systems
- Innovative (Intuitive, easy-to-use, flexible, fast and accurate, GUI driven, Mixed-Methodology) system level design tool is proposed.

Technical Objectives

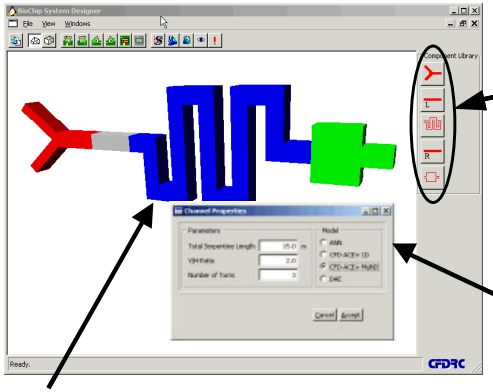
Develop a "mixed-methodology" (components characterized by Artificial Neural Networks, Differential Algebraic Equations, Analytical & Multiphysics models) , "drag & drop", component library (fluidic lego) based, system design and optimization tool for complex lab-on-chip systems

Phase I Accomplishments

- Developed hierarchical software architecture
- Developed system solver and component models
- Proof-of-concept on candidate chip demonstrated a 350 fold decrease in CPU time while retaining accuracy (error ~ 10%)

Phase II Work Plan

- Enhance the system solver and component models for multiphysics (flow, electric, capillary, hemodynamics)
- Augment GUI functionalities
- Extend the library of microfluidic components
- Validate and demonstrate the integrated design software tool for NASA & commercial applications



Biochip with Four Components: Y-Channel, Straight Channel, Serpentine Mixer and Electrochemical Sensor

Accuracy (~90%)

	CFD-ACE+ (Full 3-D Simulation)	PHASE I SYSTEM DESIGN TOOL (% Error)
Total Press. Drop (Pa)	31.65	27.5 (13.1%)
Biosensor Current (mA/m²)	809.0	745.2 (6.8%)
CPU Time (s)	5216	15

350 fold decrease in CPU time (1.5 hour to 15 seconds)

Phase I System Design Tool & Its Performance Table

NASA Applications

A system design tool for integrated biomicrosystems
NASA GRC: Biodiagnostics; NASA MSFC: Protein Chips,
NASA JSC: Biosensors for Bioreactors,
NASA Ames: Automated bioanalysis

Non-NASA Applications

Commercial: Biochip manufacturers (Aclara, Agilent, Caliper, Micronics, Tecan, Dupont, etc.), Govt. Labs (Sandia, Los Alamos, etc.), HVAC, Chemical Process

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